

Remarks:

1. General Remarks

The Applicants would like to thank the Examiner for carefully reviewing the specification and claims. The Applicants are particularly appreciative that the Examiner has found claims 2-50 to recite patentable subject matter. The above amendments to claim 1 and the remarks which follow are intended to be responsive to any ground of rejection or objection cited in the Office Action of September 22, 2004.

2. Claim Rejections - 35 U.S.C. § 102(e)

Claim 1 stands rejected as anticipated by U.S. Patent Application Publication 2002/0143470 A1 (van Borselen). To the extent the rejection may apply to claim 1 as amended, the Applicants respectfully traverse. At the outset, the Applicants respectfully note that the amendment to claim 1 is made solely for the purpose of clarifying the scope of the invention, and not to limit the scope of the claim to avoid anticipation and/or obviousness over any prior art. The amendment to claim 1 makes clear that the process of claim 1 is performed on seismic data that result from actuations of at least a first and a second seismic energy source such that there is a variable time delay between successive actuations of the first source and the second source.

Van Borselen discloses a method for separating primary events in seismic data from non-primary events. The method according to van Borselen includes sorting data by frequency so as to produce a frequency-sorted gather. The frequency sorted gather provides that at least some non-primary events are separated from primary events. Amplitudes above a selected threshold are then removed from the frequency-sorted gather. A coherency filter is then applied to the amplitude-attenuated, frequency-sorted gather. Finally, amplitudes from the coherent events are used to replace amplitudes in the attenuated, frequency-sorted gather. The process described in van Borselen has as one objective the attenuation of non-primary events such as multiple reflections and ghosts.

The purpose of the Applicants' invention is quite different. As recited in the Applicants' specification:

[0001] In marine seismic surveying, it is known in the art to increase the effective subsurface length of coverage of a seismic streamer by using an

additional seismic energy source at a spaced apart position along the survey line (direction of travel of the seismic vessel). The additional seismic energy source may be towed ahead of or behind the vessel that tows the other source and/or the seismic streamer(s). Generally speaking, methods known in the art include firing the first source and recording signals resulting therefrom, waiting a selected delay time to allow seismic energy from the first source to attenuate, and then actuating the second source. U.S. Patent No. 5,761,152, which is assigned to the assignee of the present invention, describes a method and system for marine seismic surveying which increases the fold (number of recorded reflections from a same reflector), and hence the signal-to-noise ratio of seismic signals, without incurring the problems of drag, entanglement, complicated deck handling, and decreased signal-to-noise ratio associated with increased streamer length, increased number of streamers, and increased distance between streamers. Source and streamer "offsets", and time of firing of lead and trailing vessel sources in a time delay sequence are optimized to increase the fold while avoiding any influence by the seismic signals resulting from the source of one vessel on the seismic signals resulting from the source of the other vessel.

[0002] A limitation to methods known in the art for using more than one seismic source, such as disclosed in the '152 patent, for example, is that it is necessary to wait a substantial amount of time, typically several seconds or more, between firing the first source and firing the second source, to enable identification of the energy in the recorded seismic signals as having been caused by the first or the second source. Such identification is necessary in order to properly interpret subsurface structures from the detected seismic signals. The waiting time between firing the first source and the second source reduces the speed at which seismic surveys can be recorded, and thus reduces the efficiency of making such surveys. Accordingly, it is desirable to be able to reduce the waiting time in multiple source seismic surveys to a minimum.

More specifically, seismic data used in a process according to the invention of claim 1 result from actuations of at least a first seismic source and a second seismic source such that a time delay between firing the first and the second source varies between each successive actuation. In the method of claim 1, the seismic signals resulting from actuating the first source are first sorted such that they are coherent in all spatial directions. Then the sorted signals are coherency filtered. The original signals are then sorted such that they are coherent with respect to actuation of the second source in all spatial directions. The second-source sorted signals are then

coherency filtered. The Applicants respectfully note that nothing in the van Borselen publication relates to seismic data acquired using successive actuations of a first and a second source wherein a time delay between successive firings is varied. Further, nothing in van Borselen discloses or suggests sorting seismic data such that signals are coherent with respect to a firing of a first source in all spatial directions and then sorting the data such that signals are coherent with respect to the second source. Accordingly, the type of data processed according to van Borselen is different from the type of data processed according to claim 1, and the two distinct sorting elements recited in claim 1 are not performed by any process disclosed in van Borselen. Accordingly, claim 1 is not anticipated by van Borselen.

Claims 2-15 ultimately depend from claim 1 and are patentable for at least the same reasons advanced with respect to claim 1. Claims 16-50 stand allowed.

The Applicants believe that this Reply is fully responsive to each and every ground of rejection or objection cited in the Office Action of September 22, 2004 and respectfully request early favorable action on this application.

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Respectfully submitted,



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